DYNAMOMETER CAR TESTS FOR 1902

BY

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AND

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THESIS FOR DEGREE OF BACHELOR OF SCIENCE
IN MECHANICAL ENGINEERING

COLLEGE OF ENGINEERING
UNIVERSITY OF ILLINOIS

PRESENTED JUNE 1902

S.n.5

UNIVERSITY OF ILLINOIS

May 29, 1902 190

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

John McBeath Snodgrass and Floyd Ludwig Swanberg

ENTITLED Dynamometer Car Tests for 1902

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

OF Bachelor of Science in Mechanical Engineering

L. P. Breckenridge

HEAD OF DEPARTMENT OF Mechanical Engineering

REPORT OF THE OPERATION OF DYNAMOMETER CAR # 609 AND OF RAILWAY TEST CAR # 17

Between

JUNE 1ST, 1901 AND JUNE 1ST, 1902.

The object of this thesis is to make a report of the work done with the two cars between June 1st, 1901 and June 1st, 1902.

DYNAMOMETER CAR #609.

The dynamometer car #609 was not in operation between the dates June 1, 1901 and June 1, 1902. The car has not been used during this time mainly on account of the track inspection apparatus, with which it was equipped, having been taken down in order that that apparatus might be redesigned and reconstructed. During the year this apparatus has been largely redesigned and in part reconstructed at the University shops.

RAILWAY TEST CAR #17.

During a part of the months of June and July, 1901, Railway

Test Car #17 was rented by the Brooks Locomotive Works of Dunkirk, New York to make tests of their engines on the Central Railroad of New Jersey.

The car left Champaign on Saturday, June 15th, 1901 and arrived in Wilkes-Barre, Pennsylvania on June 19th. From this date until July 18th it was in use on both passenger and freight service on the lines of the Central Railroad of New Jersey between Jersey City and Scranton, and also on passenger trains of the Baltimore and Ohio Railroad between Jersey City and Philadelphia.

The tests of freight trains were made in order to aid in establishing a tonnage rating and also to find the maximum drawbar pull of two classes of Brooks engines. The passenger train tests were undertaken in order to provide information concerning the cost of running trains at high speed.

During this time 30 tests were made, the records of which are the property of the Central Railroad of New Jersey and of the Brooks Locomotive works.

On October 7th, 1901 the car was in operation in the Champaign Yards and on the main line of the Illinois Central Railroad south of Champaign for the purpose of calibrating the dynamometer recording apparatus and establishing the position of the datum

line.

The Test Car was in use between October 23rd and November 27th in tests made for Mr. Bion J. Arnold of Chicago, who had been retained by the New York Central Railroad to advise them concerning the proposed change from steam to electric motive power in their Park Avenue Tunnel in New York City. The test car was used to provide information needed in this connection.

The car left Chicago on October 23rd on the Lake Shore and Michigan Southern Railway and dynamometer tests were made on the various trains of the Lake Shore and Michigan Southern Railway and the New York Central and Hudson River Railway, in which it was operated during the run from Chicago to New York. During this time 7 tests were made.

The car arrived in New York City on October 28th, after a detention of two days at Albany.

From October 28th until November 20th it was in use on the Hudson River Division, Harlem Division and Putnam Division of the New York Central and Hudson River Railway. During this time 49 pulling tests were made on the through line and suburban passenger trains. The trains in which the car was operated during these tests were so diversified in respect to length, tonnage, speed, number of stops and amount of traffic handled

that they would fairly represent all classes of passenger service over these lines. The test runs varied in length from 22 to 165 miles, the greater number being from 22 to 50 miles long.

The data of these tests are the property of Mr. B. J. Arnold and are on file in his office. Between December 6th, 1901 and January 4th, 1902 the writer assisted in working up a portion of this data which related to that part of the New York Central System extending from the Grand Central Station to Mott Haven Junction, a distance of 5.3 miles. The results obtained are the property of Mr. B. J. Arnold.

On November 20th the car was taken to the works of the General Electric Company at Schenectady, New York where it was used (in connection with a motor car, equipped with various kinds of electrical measuring apparatus) for making a series of comparative tests of two steam locomotives of the New York Central and Hudson River Railway and two electric motor cars. These tests, 101 in number, were carried on on an experimental third rail trolley road of the General Electric Company and also upon the main line of the New York Central and Hudson River Railway. These tests were completed November 26th. The car was then released and returned to Albany and from there to Chicago where it arrived

December 7th.

The data of these tests are the property of Mr. B. J. Arnold and of the General Electric Company.

From November 26th to December 6th the writer, together with five other men representing Mr. Arnold's office and the General Electric Company, was engaged in working upon this data. A report was made of this work which is upon file at the General Electric Company's office, at Mr. Arnold's office, and in the Railway Engineering Department of the University of Illinois.

TESTS MADE WITH TEST CAR NO. 17 DURING SECOND SEMESTER OF YEAR 1901-1902 ON WESTERN LINES OF THE ILLINOIS CENTRAL RAILROAD.

During February and March, 1902 eighteen tests were made on the western lines of the Illinois Central Railroad by the railroad company and the Railway Engineering Department of the University of Illinois. The first eight tests were made between Freeport, Illinois and Waterloo, Iowa, four of which were from Freeport, Illinois to Waterloo, Iowa and four from Waterloo, Iowa to Freeport, Illinois. Nine of the eighteen tests were made from Dubuque, Iowa, over what is called the Dubuque Hill, to Peosta, Epworth or Farley according to the conditions of the side tracks at the several places. The last test was made from Dubuque, Iowa to Freeport, Illinois.

The objects of the first eight tests were:

1st. To collect such data and information as would enable the railroad company to establish a tonnage rating between Freeport, Illinois and Dubuque, Iowa by determining the maximum number of tons that could be hauled over the ruling grades.

2nd. To determine the exact performance of the two engines which were used on the tests. These two engines were tested under similar conditions.

Some trouble had been experienced with engines making the through run from Freeport, Illinois to Waterloo, Iowa. Often the steaming qualities of the boilers were seriously affected, the trains did not make schedule time and occasionally the engine would give out while on the road. The fires would be in bad condition and the boiler tubes would leak to such an extent that it was necessary to make boiler repairs. The engines were often detained from going out on the next regular run.[1]

To accomplish these two objects at the same time the following records and observations were taken:

In the test car.

1. Continuous curve of draw bar pull on a distance base.
2. Continuous curve of speed on a distance base.

[1]See table No.5 for engine dimensions and weights.

3. Continuous time record - Intervals of 5 seconds, recorded on dynamometer chart.

4. Time marked on dynamometer chart at intervals of 2 or 3 minutes.

5. Time of starting and stopping.

6. Mile posts and stations were marked on dynamometer chart.

7. Location and number of indicator cards were marked on dynamometer record.

In the engine cab.

8. Number of indicator card.

9. Throttle position.

10. Reverse lever position.

11. Steam pressure.

On front end of engine.

12. Revolutions per minute of drivers.

13. Indicator card taken during time of taking revolutions.

The height of water in tank was read at front and rear of tank, at the beginning and end of each test and at such times as water was received.

The amount of coal used was taken as the weights given by the engineer. No special attempt was made to weigh the coal or to measure the water accurately.

Train data: A train list was made out for each test, giving the number, owner's name, kind, light and loaded weights of all the cars. From this list the tonnage and length of train was determined. The condition of wind, weather and rail were noted and recorded with the general information. The general data for this series of tests are found in tables 1 and 2 which follow.

THE METHOD OF TAKING DATA.

Items 1, 3, 4, 5, 6 and 7 were all taken in the Test Car and all recorded on dynamometer chart.

Item 2. The speed curve was also taken in the Test Car by the Boyer Speed Recorder and upon it were marked the mile posts and stations.

Items 8, 9, 10 and 11 were noted at the time of taking indicator cards by one observer in the cab, who gave signals to the front end of engine and to the Test Car.

Item 12. The revolutions were taken by a continuous counter placed on the front end of the engine and driven off the indicator reducing motion. The counter was read on signal from the cab when the time and other cab observations were taken.

Item 13. Indicator cards were taken on the right or left side of the engine as previously stated. These cards were taken on signal from the cab and in the middle of the interval during which the revolutions were counted. A Crosby indicator was used and the scale of the spring used for all cards and in all tests was nominally 100 lbs. per inch. This spring was calibrated after the tests and the scale found to be 98.93 lbs. per inch.

In tests 1, 2, 3, 4 and 5 engine number 46 was fitted up with indicator on left side and in tests 6, 7 and 8 engine number 504 was fitted up with indicator on right side.

Observations were frequently made to determine the condition of fire and boiler flues.

The object of tests No. 9 to No. 17 inclusive was to determine the relative train resistance for different kinds and lengths of trains. The trains for these tests were made up with that end in view. Six trains were made up entirely of cars of the same general build and three trains were made up of different kinds of cars, such as coal, box and stock cars, or otherwise. The tonnage was about the same for all trains.

The last test was made from Dubuque Iowa to Freeport, Illinois. The train was composed of different kinds of cars. The usual readings were taken in the Test Car and on the engine.

The tests covered a period of three weeks and the following tables give the general information about each test.

ENGINE DATA. TABLE NO. 5.

Engine number	46	504
Type	10 wheel	Mogul.
Weight on drivers	122300#	106400#
Total weight of engine, loaded	157200#	126000#
Diameter of cylinders	20"	19"
Stroke of piston	28"	26"
Diameter of piston rod	4"	3-1/2"
Diameter of piston rod extension	2-3/4"	None
Number of driving wheels	6	6
Diameter of driving wheels	63"	56-1/2"
Number of truck wheels	4	2
Diameter of truck wheels	33"	33"
Type of boiler	Ext.Wagontop	Belpaire
Diameter of boiler	66"	62"
Working pressure	200#	165#
Length of fire box	120"	114"
Width of fire box	32-3/4"	33-3/8"
Number of tubes	304	236
Diameter of tubes (O.D.)	2"	2"
Length of tubes	13'-11-3/8"	11'-1"
Heating surface, sq.ft.	2204	1358
Heating surface, fire box, sq.ft.	192	173
Heating surface, total, sq.ft.	2396	1531
Grate area, sq.ft.	27.2	26.4
Total weight of tender, loaded	102500#	94900#

TABLE NO.1

GENERAL LOG OF TRAIN DATA

TAKEN ON

WESTERN LINES OF ILL. CENTRAL R. R.

TEST NO.	DATE	TEMPER-ATURE	WEATHER CONDITIONS	RAIL CONDITIONS	NO. OF MILES	BEGINNING OF TEST	END OF TEST	REMARKS
1	2	3	4	5	6	7	8	9
1	FEB. 18+19	10° + 0°	CLEAR, DRY, AND COLD		152	FREEPORT ILL.	WATERLOO IOWA	STALLED TWICE, SET OUT CARS
2	" 20+21	6° + 10°	" " " "	FROSTY	152	WATERLOO IOWA	FREEPORT ILL.	" 4 TIMES " " "
3	" 22	15°	CLOUDY " "	"	152	FREEPORT "	WATERLOO "	
4	" 23+24	32°	CLEAR " "	FROSTY AT START	152	WATERLOO "	FREEPORT "	RATHER HEAVY WIND THROUGHOUT TEST FROM FORWARD LEFT QUARTER
5	" 24+25	45° + 24°	" DRY " "	GOOD, FROSTY	152	FREEPORT "	WATERLOO "	
6	" 26+27	35° + 41°	CLOUDY, " RAIN AT 11:30		152	WATERLOO "	FREEPORT "	
7	" 27+28	52° + 42°	HEAVY RAIN, DRIZZLING		152	FREEPORT "	WATERLOO "	STALLED SET OUT CARS
8	MCH. 1	28°	CLOUDY, COLD, LIGHT WIND		152	WATERLOO "	FREEPORT "	" TWICE " " "
9	" 3	25°	" DRY AND COLD	GOOD	23	DUBUQUE "	FARLEY "	" " DOUBLE TO STA.
10	" 3	33° AT 2 P.M.	" " " "	"	23	" "	" "	
11	" 4	26°	CLEAR " " "	"	23	" "	" "	
12	" 4	36° AT 3 P.M.	" " " "	"	15	" "	PEOSTA "	
13	" 5	26°	" " " "	"	19	" "	EPWORTH "	TRAIN BROKE IN TWO
14	" 5	45°	" " " "	"	15	" "	PEOSTA "	IN ALL TESTS, EXCEPT
15	" 6	38°	" " " "	"	23	" "	FARLEY "	NO.5 EITHER A LIGHT
16	" 6	52°	" " " "	"	23	" "	" "	OR NO WIND PREVAILED.
17	" 6	50°	" " " "	"	15	" "	PEOSTA "	
18	" 7	38°	CLOUDY AND DAMP	"	69	" "	FREEPORT ILL.	

TABLE NO.2

TRAIN DATA

TAKEN ON

WESTERN LINES OF ILL. CENTRAL R. R.

TEST NO.	ENGINE NO.	TRAIN NO.	TONNAGE AT START	KIND OF TRAIN	NO. OF CARS	NO. OF LOADS	NO. OF EMPTIES	NUMBER OF VARIOUS KINDS OF CARS								NO. OF CARDS TAKEN	REMARKS
								COAL	BOX	STOCK	FURN	REFRIG.	FLAT	TEST	CABOOSE		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
1	46	1ST. 83	1163.4		30	27	3							1	1		
		87	838.7		28	19	3							1	1		
2	46	2ND. 82	942.2		27	25	2							1	1		
		1ST. 86	897.5		27	25	2							1	1		
3	46	81	1021.2	MIXED	25	23	2	8	13	0	0	0	2	1	1		
4	46	1ST. 82 2ND. 82	836.3	MIXED	38	15	23	17	18	0	0	1	0	1	1		
5	46	6TH. 83	1043.	"	29	25	4	12	12	3	0	0	0	1	1		
		83	774.4	ALL BOX	34	9	25	1	6	23	1	1	0	1	1		
6	504	1ST. 82 EXTRA	750.	ALL BOX	21	19	2	0	18	0	1	0	0	1	1		
7	504	2ND. 83	1060.9	MIXED	29	26	3	11	14	1	0	1	0	1	1		
		2ND. 87	708.4	"	20	18	2	4	12	1	1	0	0	1	1		
8	504	1ST. 82	808.4	ALL BOX	22	19	3	2	17	0	0	1	0	1	1		
9	504	87	716.0	" "	21	19	2	0	17	0	0	0	0	1	1	35	
10	504	EXTRA	623.1	" "	19	17	2	0	14	2	0	0	1	1	1	31	
11	504	87	625.2	" COAL	15	13	2	12	1	0	0	0	0	1	1	32	
12	504	1ST. 82	640.4	MIXED	19	17	2	0	13	0	2	OIL 1	1	1	1	28	
13	504	85	614.6	ALL STOCK	34	0	34	0	0	32	0	0	0	1	1	33	
14	504	1ST. 81	626.1	" BOX	22	15	7	1	12	0	1	5	1	1	1	24	
15	504	EXTRA	638.4	" COAL	16	14	2	14	0	0	0	0	0	1	1	29	
16	504		630.3	" "	13	11	2	11	0	0	0	0	0	1	1	34	
17	504	EXTRA	591.6	MIXED	39	0	39	16	12	0	6	2	1	1	1	26	
18	504	EXTRA	586.7	"	42	0	42	33	4	0	1	2	0	1	1	46	

TESTS ON NORTHERN LINES OF THE ILLINOIS CENTRAL RAILROAD BETWEEN CHAMPAIGN AND DORANS OR MATTOON, MADE DURING MARCH AND APRIL 1902.

From March 19th to April 7th twelve tests were made from Champaign to Mattoon and return, and four tests were made from Champaign to Dorans and return. The tests going to Mattoon or Dorans were made on through freight trains and the tests made from Mattoon or Dorans to Champaign were made on local passenger trains.

In all the tests from Champaign to Dorans or Mattoon the Test Car was running backward and in all the tests from Mattoon or Dorans to Champaign the Test Car was running forward.

The objects of this series of tests were:

1st. To familiarize the junior and senior engineering students with the methods and apparatus used in recording data necessary for the calculation of train resistance and to show them the operation of the Test Car.

2nd. To obtain additional data for calculating train resistance.

The students accompanying the Test Car during these tests were members of the junior and senior classes of the Mechanical Engineering Department, of the junior class of the Civil Engineering Department, and of the senior class of the Electrical Engineering Department. The classes were divided into sections of about ten and each section made one round trip, leaving Champaign between 7:30 and 8:30 A. M. and returning at 2 P. M. the same day.

The men accompanying the car on these tests are given in the following lists:

Tests Nos. 1 and 2.		Tests Nos. 3 and 4.	
Post	Brown	Higgins	Samson
Cowley	Carter	McCarthy	Mount
Shimmin	Johnson, F.V.	Lund	Snodgrass
Greenman	Collis	Johnson, F.D.	Swanberg
Dadant	Drew	Prof. Schmidt	
Johnson, F.D.	Snodgrass		
Prof. Schmidt	Swanberg		

Tests Nos. 5 and 6.

Cook	Drury
Dickerson	Ketzle
Green	Stewart
Fiske	Beers
Briggs	Atwood
Snodgrass	Johnson, F.D.

Prof. Schmidt

Tests Nos. 7 and 8.

Mr. Frye of the Railroad Gazette

Prof. Breckenridge

Prof. Carman

Major Fechét

Prof. Schmidt

Snodgrass

Johnson, F.D.

Swanberg

Tests Nos. 9 and 10.

Prof. M. Brooks

Prof. Brown

Mr. Oliver

Roberts	Sawyer
Wilkinson	Hanna
Wesselhoeft	Cunningham
Wolff	Johnson, F.D.
Snodgrass	Swanberg

Prof. Schmidt

Tests Nos. 11 and 12.

Rightor	Siler
Garden	Sussex
Ingersoll	Prates
Worrall	Block
Fursman	Ireland
Varnes	Burkhalter
Habemeyer	Huntoon
Johnson, F.D.	Snodgrass

Swanberg

Prof. Schmidt

Tests Nos. 13 and 14.		Tests Nos. 15 and 16.	
Dunkin	Skinner	Price	Bear
Moore	Wallace	Peterson	Richey
Kuss	Johnson, A.M.	Connelly	Le Sourd
Rutt	Park	Seymour	Kuss
Sheldon	Johnson, F.D.	Apple	Skinner
Snodgrass		Sawyer	Johnson, F.D.
Prof. Schmidt		Snodgrass	Swanberg
		Prof. Schmidt	

Each section was given such instruction as would enable them to calculate train resistance from the data taken on the Test Car. The apparatus and methods of operation were explained to each division.

The data and information pertaining to train resistance, thus obtained,was added to the data now on file in the Railway Engineering Department.

During this series of tests the following records and observations were taken:

In the Test Car.

1. Continuous curve of draw bar pull on a distance base.

2. Continuous curve of speed on a distance base.

3. Continuous time record - intervals of 5 seconds recorded on dynamometer chart.

4. Time marked on dynamometer chart at intervals of 2 or 3 minutes.

5. Time of starting and stopping.

6. Mile posts and stations were recorded on dynamometer chart at time of passing same.

Train data.

Freight trains: A list was made out for each train which gave the number of engine, number of train, number of cars, kind of cars, also light and gross weights of each car.

Passenger trains: A list was made out for each train giving the number of train, number of engine, also number of mail, baggage and express, coach and sleeping cars.

The tests covered a period of eight days, and tables No. 3 and No. 4 give the general information about each test.

TABLE NO. 3

GENERAL LOG OF TRAIN DATA

TAKEN ON

NORTHERN LINES OF ILL. CENTRAL R.R.

TEST NO.	DATE	TEMPERATURE	WIND	WEATHER CONDITIONS	RAIL CONDITIONS	NO. OF MILES	BEGINNING OF TEST	END OF TEST	NO. OF MEN ON TEST	REMARKS
1	2	3		4	5	6	7	8	9	10
1	MARCH 19	START END 30° TO 43°	NO WIND	CLEAR, DRY	GOOD	43	CHAMPAIGN ILL.	MATTOON ILL.	14	
2	" "	43° " 48°	"	" "	"	43	MATTOON ILL.	CHAMPAIGN "	14	
3	" 21	39° " 46°	LIGHT "	CLOUDY, DAMP	"	43	CHAMPAIGN "	MATTOON "	9	
4	" "	46° "	" "	" "	"	43	MATTOON "	CHAMPAIGN "	9	RECORD CALIBRATED RAINED AT 1:10 P.M.
5	" 26	56° " 58°	" "	" "	WET	38	CHAMPAIGN "	DORANS "	15	
6	" "	57° "	" "	RAINY	"	38	DORANS "	CHAMPAIGN "	15	RAINED AT 10:00 A.M.
7	" 29	55° "	" "	CLEAR	GOOD	43	CHAMPAIGN "	MATTOON "	8	VISITING TRIP
8	" "	"	" "	"	"	43	MATTOON "	CHAMPAIGN "	8	" "
9	APRIL 1	33° " 36°	" "	CLOUDY, DAMP	DAMP	43	CHAMPAIGN "	MATTOON "	14	RECORD CALIBRATED
10	" "	36° "	" "	"	GOOD	43	MATTOON "	CHAMPAIGN "	14	
11	" 3	39° - 42°	NO "	CLEAR, FROSTY	"	43	CHAMPAIGN "	MATTOON "	18	
12	" "	44° "	LIGHT "	"	"	43	MATTOON "	CHAMPAIGH "	18	RECORD CALIBRATED
13	" 4	53° "	" "	"	"	38	CHAMPAIGN "	DORANS "	13	
14	" "	56° "	" "	"	"	38	DORANS "	CHAMPAIGN "	13	
15	" 7	34° " 37°	STRONG NORTH "	CLOUDY	"	43	CHAMPAIGN "	MATTOON "	16	RECORD CALIBRATED
16	" "	37° "	" "		"	43	MATTOON "	CHAMPAIGN "	16	

TABLE NO. 4

TRAIN DATA

TAKEN ON

NORTHERN LINES OF ILL. CENTRAL R. R.

TEST NO.	ENGINE NO.	TRAIN NO.	TONNAGE AT START	KIND OF TRAIN	NO. OF CARS	NO. OF LOADS	NO. OF EMPTIES	NUMBER OF VARIOUS KINDS OF CARS										REMARKS
								COAL	BOX	STOCK	FLAT	TEST	CAB.	MAIL	BAG&EXP.	COACH	PULL-MAN	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	416	81	1381	ALL COAL	27	25	2	25	0	0	0	1	1					CONDUCTOR CONSIDERED TONNAGE UNDERESTIMATED.
2	320	24		PASS.	5							1		1	1	2	0	IN ALL THE
3			1310.6	MIXED	31	29	2	13	8	6	2	1	1					FREIGHT TRAIN
4	320	24		PASS.	6							1		1	1	3	0	TESTS THE TEST
5	411	71	1333.4	ALL COAL	25	23	2	23	0	0	0	1	1					CAR WAS RUNNING
6	320	24		PASS.	6							1		1	1	3	Private Car 1	BACKWARDS.
7	423	81	1275.6	MIXED	45	24	21	39	2	0	2	1	1					TONNAGE GIVEN
8	304	24		PASS.	5							1		1	1	2	0	INCLUDES TEST
9	404	81	1356.9	ALL COAL	29	26	3	26	1	0	0	1	1					CAR.
10	333	24		PASS.	6							1		1	1	2	1	
11	417	81	1312.	ALL COAL	27	25	2	25	0	0	0	1	1					
12	333	24		PASS.	6							1		1	1	2	1	
13	423	81	1272.8	MIXED	28	27	2	24	3	0	0	1	1					
14	333	24		PASS.	5							1		1	1	2	0	
15	407	81	1326.7	MIXED	39	37		19	17			1	1					
16	304	24		PASS.	5							1		1	1	2	0	

COMPARATIVE TESTS
KINDL SWING TRUCK

These tests were made on the Northern Lines of the Illinois Central Railroad between Makanda, Illinois and Cobden, Illinois, on April 24, 1902, by the Illinois Central Railroad and the Railway Engineering Department of the University of Illinois.

These tests were undertaken for the purpose of determining the difference in resistance of cars equipped with Kindl Swing Trucks and trains not so equipped.

The tests consisted in taking, by means of Test Car No. 17, dynamometer records of the resistance of four trains, in two of which the Kindl Swing Truck was in action. In the other two tests the rollers in the Kindl Swing Truck were prevented from acting by means of wedges, so that the cars presented - so far as their resistance was concerned - the same condition that exists in cars equipped with the ordinary trucks.

In all four tests the Test Car was running backward, so that the pull registered upon the dynamometer chart is the pull of the train behind the Test Car. The cylinder with 60 square inch net area was used throughout the tests.

During this series of tests the following records and observations were taken:

In the Test Car.

1. Continuous curve of draw bar pull on a distance base.

2. Continuous curve of speed on a distance base.

3. Continuous time record - Intervals of 5 seconds recorded on the dynamometer chart.

4. Time marked on dynamometer chart at intervals of 2 or 3 minutes.

5. Time of starting and stopping.

6. Mile posts and stations were recorded on dynamometer chart and speed curve at time of passing same.

Train data.

A list was made out for each train which gives the number of engine, number of train, number of cars, kind of cars, also stencil and gross weights of each car.

The following tables give the general information in each test. The data and a report of the results are on file in the Railway Engineering Department of the University of Illinois.

On April 29, 1902 the members of the senior class in the Mechanical Engineering Department of the University of Illinois accompanied the Test Car #17 from Champaign to Chicago, and returned from Chicago to Champaign on May 5, 1902. A test was run from Champaign to Kankakee. Records were taken which are similar to those obtained on the tests run from Champaign to Mattoon. This was the annual inspection trip for the members of the senior class in Mechanical Engineering.

TABLE NO. 6

GENERAL LOG OF TRAIN DATA

TAKEN ON

NORTHERN LINES OF ILL. CENTRAL R.R.

TEST NO.	DATE	TEMPER-ATURE	WEATHER CONDITIONS	RAIL CONDITIONS	NO. OF MILES	REMARKS
1	2	3	4	5	6	7
1	ARRIL 24	64° AT 10:00AM	CLEAR, DRY, LIGHT WIND	GOOD	6	ROLLERS IN ALL CARS BLOCKED OUT OF ACTION
2	" "	72° " 1:00 PM	" " " "	"	6	SET OUT 12 CARS
3	" "	73 " 3:45 "	CLOUDY " NO "	"	6	WEDGES REMOVED AND ROLLERS IN ACTION
4	" "	73 " 5:10 "	" " " "	"	6	SAME AS TEST NO. 3

TABLE NO. 7

TRAIN DATA

TAKEN ON

NORTHERN LINES OF ILL. CENTRAL R.R.

TEST NO.	ENGINE NO.	TRAIN NO.	TONNAGE BEHIND CAR NO. 17	KIND OF TRAIN	NO. OF CARS	TEST	CABOOSE	REMARKS
1	2	3	4	5	6	7	8	9
1	586	85	1299.8	ALL COAL	23	1	1	ALL CARS CLEAR OF SIDE BEARINGS EXCEPT FOUR
2	586		649.3	" "	11	1	1	
3	586		654.	COAL AND ONE COACH	11	1	1	SWING TRUCKS IN ACTION
4	586		1299.8	" "	23	1	1	" " " "

During all of the tests mentioned above the writers have aided in the operation of the dynamometer cars and later in the calculation of the results. Such data and results as are not presented in this thesis are, except where otherwise noted, on file in the Railway Engineering Department of the University of Illinois.